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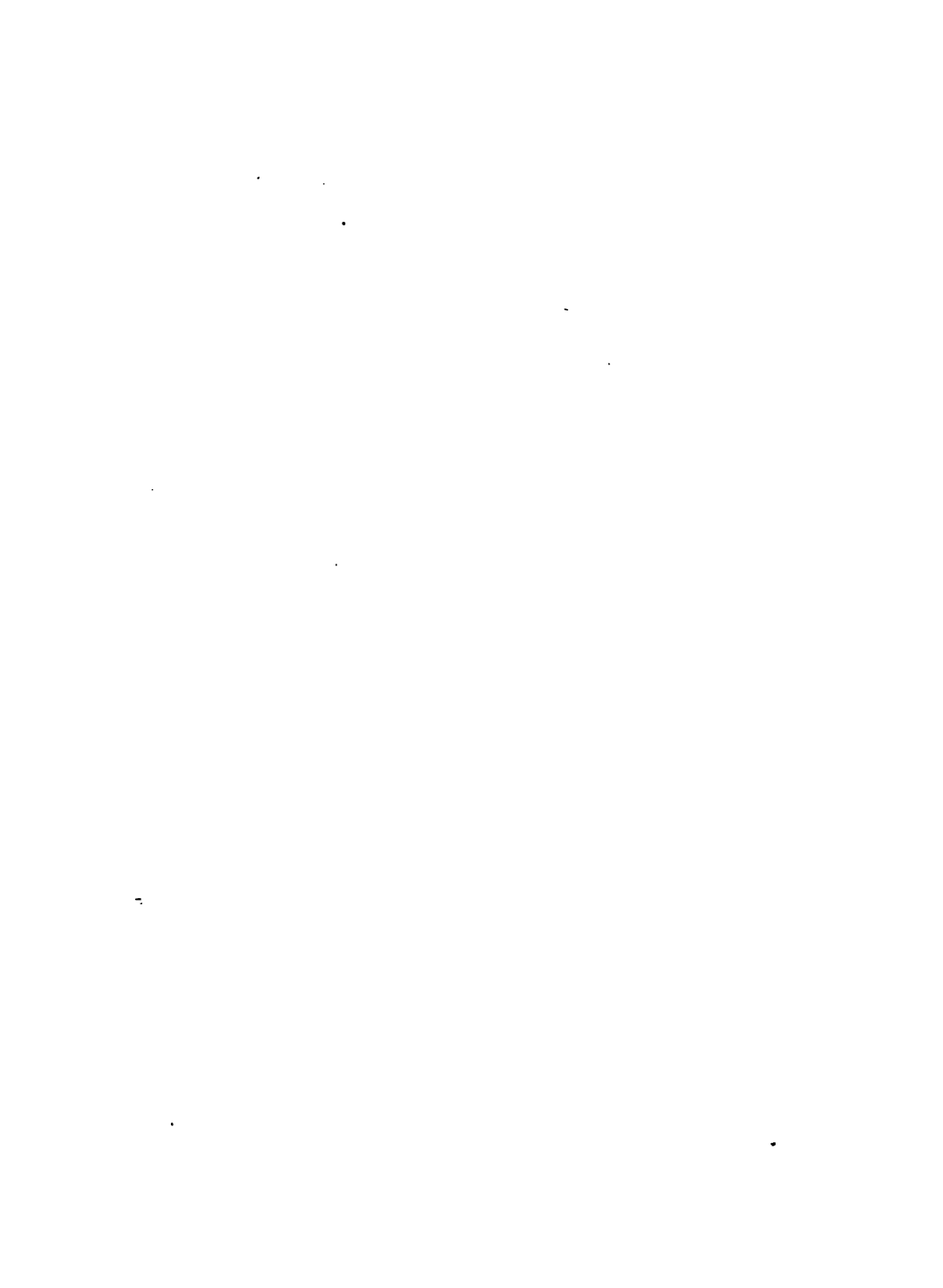
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BODY
MECHANICS
AND
HEALTH
—
HOMAS
—
GOLDTHWAIT

1781
T45
1922



GIFT
Dr. H. Langnecker



Nature has done her best: do thou thine.

MILTON.



FIG. 1. Correct standing position

BODY MECHANICS AND HEALTH

BY
LEAH C. THOMAS
AND
JOEL E. GOLDTHWAIT, M.D.



HOUGHTON MIFFLIN COMPANY
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PREFACE

WE believe that the highest aim of physical education is to develop human beings best fitted to cope with the conditions of modern civilization. If physical education is to accomplish this purpose, it must be presented from a more fundamental basis than it has been in the past. The authors have come to this conclusion through wide observation and through experience in directing physical training in a school system of two thousand pupils.

We are convinced that the day must come when the type of work here outlined is better standardized and more generally adopted by physical directors and teachers. These same principles form the basis of corrective and individual gymnastics as taught by physio-therapists. When they are applied to larger groups it seems obvious that normal growth and development can effectively be gained through this particular approach to physical education.

Body Mechanics and Health has been written in the hope that it may be of practical use to many who direct the physical education of the children in our schools, and that through the application

of these principles the importance of our message will become more widely appreciated.

Thanks are extended to Dr. Robert B. Osgood for his interest and assistance in the preparation of this work.

L. C. T.

J. E. G.

INTRODUCTION

By MARGUERITE SANDERSON

Boston School of Physical Education

THE efficiency of the individual depends to a very considerable extent upon the way in which the body is used. The strong, erect figure is desired not only for military fitness, but is being demanded more and more in industry, as well as being recognized as the basic element of health.

The real purpose of physical education should be to obtain this ideal. To those who have studied the matter carefully, it must be realized that many of the systems of physical education in vogue result in excellent coördination of the muscles without obtaining the best body mechanics. It is the common experience to see a class execute most complex drill with the body in fairly good poise as the special exercise is being performed, but to see the members of the class relax as soon as the exercise is over into positions that are anything but ideal. As with the army the results were the only thing considered, the technique mattering not so long as the results were good, so with systems of exercise, each must be judged by the results obtained.

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BODY MECHANICS AND HEALTH

I

GENERAL VIEWS OF PHYSICAL EDUCATION

Good body mechanics means the correct poise and control of the body with the normal functioning of every organ. It is our aim to bring before physical directors and teachers the importance of good body mechanics and to give a practical set of exercises which concentrate on the normal development of the torso. We believe the value of arm and leg exercises is greatly over-rated, and in consequence are too prevalent in the present day's order.

No attempt has been made to cover special corrective cases, such as curvatures, but only to emphasize the serious results of faulty posture which is intimately associated with ill-health and inefficiency of the body. Until the majority of men and women are brought to the highest standard of physical fitness, our physical education system fails to fulfill its purpose. That it has fallen short of the desired end seems evident

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from a survey of a representative group of college students. General fitness and highest physical efficiency are suggested in the type of man chosen for competitive athletics. (Fig. 1.) With this



FIG. 2. Incorrect standing position

figure it is evident that not one ounce of energy is wasted because of undue strain from imperfect poise. Contrast this with Fig. 2. Actual statistics show that eighty per cent of the men in the freshman class of a leading university fall far below the normal standard of development. In view of this a department for special posture work has been organized. If this means that more than half of the men in a college freshman class are not fit subjects for a football team, if more than half are not desirable candidates for the crew, if more than half would not be permitted to enter an institu-

tion such as West Point where men are selected in view of physical efficiency, certainly little credit

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is due our present-day system of physical education in preparatory schools. We are far from proud of the large number of men classed by our War Examining Boards as "physically unfit" for service. The strong, healthy, well-built men in our country should be the predominating type rather than the exception. The failure to develop such men is due partly to the lack of understanding of the fundamental principles of good health and partly because schools of physical education and colleges place too much emphasis on the methods of teaching and too little emphasis on practical methods of health-building.

A brief consideration of the varied character of the work required of the human body may help us to appreciate the importance of proper body mechanics. "Not only is the human machine one of extremely delicate adjustment or balance, but in its use greater variation is demanded in the character of the work performed than would be considered possible in any other conceivable mechanism. Not only are the muscles subjected to varying degrees of strain, but all the visceral functions, as well as the higher mental processes, require an adjustment of the organism as a whole which must make possible wide latitude in the amount of energy that each part can reasonably use. Not only must the amount of energy to be

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expended vary, but the method of use of any part must also vary, since, for example, the body must be used not only in one plane, but in any possible plane in which it may be placed. The visceral functions, as well as the physical activities, must be possible whether the body is erect or prone, whether straight or flexed, whether in dorsal, dextra, sinistra, or anterior decubitus, and many of the functions must go on whether the conscious control of the organism, such as exists in the waking hours, is present or not. With so much of adjustment necessary and with such great diversity in the character of the work required, it is obvious that all necessary friction or strain should be eliminated so that the greatest amount of energy may be available for the accomplishment of the special task, and at the same time the machine may not be damaged, or, in other words, that the health of the individual may not be impaired."

Universally physical education is associated with exercise in many different forms, such as gymnastics, dancing, athletics, and games. So far as the interest of the professionally trained person is concerned, exercise oftentimes dissolves itself into some one particular form. The specialized teacher in æsthetic dancing aims to produce an almost perfect dance from a technical

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standpoint. The same is true of a specialized teacher in folk-dancing. The teacher of formal gymnastics approaches his work from an educational standpoint. The teacher of games has the welcomed recreational viewpoint from which to start. The average public school physical education teacher follows as nearly as possible the old time-honored Swedish day's order. More than the accustomed number of arm and leg exercises are of necessity introduced. These do not begin to approach the ideals of the teacher, not to mention the needs of the children, because they are restricted by the construction of the schoolroom.

The following theory breaks away from the old technique of exercise and traditional ideas, such as supposing that all exercise is good, beneficial, and healthful. It is not. The most fundamental and at present a most unappreciated fact is the value of the proper mechanical working of the body. Until a person understands good body mechanics and has gained the correct muscular coördination, chiefly of the abdomen, chest, and back, exercise is of little benefit and often is harmful. If a person is taught how to correct his own bad posture and aims to make a good posture habitual, he has gained more than the benefits from many strenuous exercises taken with the body poorly poised. Little will be gained from

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a half-hour of strenuous exercise with the body held in the best possible position if the remaining twelve or fourteen hours of the day are spent with the body badly poised. "When the body is used rightly or fully erect, the feet, knees, hips, spine, shoulders, head, and all portions which represent the frame of the body, are used in balance, with the greatest range of movement possible without strain. In this position, the chest is held high and well expanded, the diaphragm is raised, and the breathing and heart action are performed most easily. The abdominal wall is firm and flat, and the shape of the abdominal cavity resembles an inverted pear, large, and rounded above, small below. The ribs have only a moderate downward inclination. The subdiaphragmatic space is ample to accommodate the viscera. In this position, also, there is no undue pressure upon, or interference with, the pelvic viscera or with the large ganglia at the back of the abdomen and in the pelvis." On the other hand, "if the body is drooped or relaxed, so that the shoulders drag forward and downward, the whole body suffers, the weight is thrown imperfectly upon the feet, so that the arch must be strained; the knees are slightly sprung, which shows by the crepitating joints; the pelvis is changed in its inclination, with strain to the sacro-iliac joints and low back. In

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this position the chest is necessarily lowered, the lungs are much less fully expanded than normal, the diaphragm is depressed, the abdominal wall is relaxed so that with the lessening support of the abdominal wall, together with the lowering of the diaphragm, the abdominal organs are necessarily forced downward and forward. (Fig. 14.) It is by such an understanding of the conditions, with the appreciation that the stomach and liver cannot work rightly if the ribs are contracted and narrowed so that there is practically no subdiaphragmatic space; that the pelvic organs cannot work rightly and must be congested if the loose abdominal organs are crowded into the lower abdomen and pelvis, so that the nutrition must suffer, and the physiology in general must be abnormal if the anatomic conditions under which the physiological function is expected to be performed are so markedly abnormal." (Figs. 2 and 14.) If physical education does not lead to functional development, it fails to build a foundation for future health.

This work demands teachers who recognize the importance of body mechanics as a foundation for their work. It is possibly the only phase of corrective work which can be carried on satisfactorily in groups. Where can one not find a gymnasium class in which a large part of its mem-

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bers is standing in a poor posture, stretching the arms sideward, upward, forward, and downward, energetically exercising the biceps which is sufficiently exercised in the daily use of the arm. The physical training period should be devoted to the development of trunk muscles which are the key-notes to good posture, and in our daily lives are not usually brought properly into action. Unless this is done, the neck, abdominal, back, and leg muscles are apt to be out of proper balance, resulting in poor mechanics. This viewpoint appeals to the adult much more than to children. A mature mind understands what is to be accomplished and the value of the end result. Children prefer to play games. They like folk-dancing. They like the group spirit. However, the ideal time for posture training is in childhood, in the habit-forming years, when wrong mechanics are more easily prevented than cured. If taught individually or in small groups, children at the age of five or six will understand the correct posture well enough to gain most satisfactory results.

Who has not seen a class (Fig. 3) doing excellent work from an educational standpoint? Should not the individuals first be taught to stand correctly, to use the body to the best advantage with the least expenditure of energy? Let the educational work follow and results will be



FIG. 3. Bad posture of gymnasium class



FIG. 4. Good posture of gymnasium class

better. (Fig. 4.) Who has not seen this child (Fig. 5) anxiously waiting his turn to run in an exciting relay race? The idea is excellent from a



FIG. 5. Bad posture for relay race



FIG. 6. Good posture for relay race

recreational standpoint, but if the boy had been taught how to stand correctly and the advantages of the correct posture, one would never find him in this position hoping to win a race. (Fig. 6.) What child from six to fifteen years of age does not normally exercise a great deal each day? He runs part way to school, he hops part way, he plays tag, Red Rover, or Hide and Seek just before he enters the classroom. This exercise is

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beneficial if his body is used correctly. It is harmful if used incorrectly, thus daily expending too much energy, resulting in the physically and



FIG. 7. *Æsthetic dance* —
bad posture

nervously fatigued child. Who has not seen this high-school or college girl (Fig. 7) ready to interpret an æsthetic dance? Graceful use and ease of balance of the body can come only as the result of a well-poised body.

The importance of the proper body mechanics is often not well understood even in the medical profession, but physicians thinking along these lines show us not only the benefits of good mechanics, but also prove that the body demands its normal posture to maintain perfect health.

The trained athlete, with strong, well-developed arm and leg muscles, sometimes finds himself in the hands of a doctor because of a weak back. Runners may have marked dispro-


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portion between the size of chest and shoulders and development of their legs. These people do one thing well at the expense of other things. Equal development of all parts is more desirable. Soldiers many times have too high a chest with an increased lumbar curve. This may account for many cases of the flat feet so commonly found in the army. In the same way the round shoulders may well be due to the improper carrying of packs.

The rules and principles for acquiring and maintaining the proper mechanics of the body in its anatomic correct position are so few and so simple they offer little excuse for neglect in this work. Emphasize, stand tall, head up, chin in, chest high, abdomen flat, weight on balls of feet. Never overcorrect the chest, which tends to carry the shoulders too far back and to increase the lumbar curve, causing the body weight to fall on the heels. Always consider the body as a whole. Do not look only at a localized deformity because its causes and results are too far-reaching, oftentimes working round in a vicious circle. Departure from the normal poise causes abnormal strain. It must be appreciated that while the chief effect of the strain may show most markedly in one part, nevertheless, the whole body under such circumstances must be affected.

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The exercises compiled in the following chapters develop a coördination of the trunk muscles giving the body proper muscular balance, with the ideal in mind of ultimately developing an habitually well-poised body. Training acrobats to perform stunts or training a small group of men to run a race in the shortest possible amount of time is not the most worthy calling in the physical training profession. Such training fails to prepare the human machine for the stress and strain of our present-day busy lives. The aim should be to develop the highest physical efficiency for the largest possible number of people. The ability of the physical director should be judged by his knowledge of body mechanics as an essential in his technical training. This work has been tried sufficiently to prove that if it formed the foundation of all physical education, our present system would be more effective in developing stronger and healthier men and women. Not only is the physical side of our nature important, but also it must be recognized that there is a definite relationship between the mental and physical powers. Generally speaking, men and women possessing great mental efficiency have physical strength back of it. We do not mean necessarily great muscular development, although the physical strength of Abraham Lin-



coln and Theodore Roosevelt were admittedly great assets to their intellectual careers. On the negative side we find that in different classes of human beings, such as the moron, the feeble-minded, and the idiot, there is a certain ratio between their mental and physical control without which control no efficiency is attainable. The degree of physical coördination and control obviously increases with increased mental development. Our conviction is strong that with the ideal posture and practiced control the physical powers are at their best, the mental functions performed most easily, and the personality or spirit of the individual possesses its greatest strength.

II

REST

REST may well be called "natural therapeutics." Physiological as well as mechanical rest is important enough to demand serious attention. Nature's powers are great to repair sources which have suffered exhaustion — to renovate bodily strength and to restore mental vigor. Rest and growth are so closely associated that they appear on superficial view to stand in relation to each other as cause and effect. The child who sleeps much thrives best. The wakeful, restless child seldom displays the evidence of active nutrition. In infancy development is in its highest state of activity, and it is at this time that the healthy child passes the greater portion of its life in a state of rest and sleep. Rest and sleep are component parts of growth. Repair is but a repetition of growth. Children show signs of loss of rest much more quickly than older people, which suggests a greater demand for rest in childhood than in adults.

All organs as well as the brain require the alternate condition of activity and rest to keep them vigorous and in health. If the necessary amount

of rest is not acquired, structural changes and deterioration of function are sure to follow. In reference to the etiology of the disease of individual organs, it may be asserted that a large proportion of their diseases originate in circumstances which deprive the organ of rest which is necessary for the performance of its healthy function.

For conserving energy and maintaining good posture, change of position is necessary. It is not natural for children or adults to keep one position. This instinct to move about is checked in the schoolroom. Note in the first and second grades the seemingly unlimited amount of nervous energy each child is expending simply to meet the requirements of the classroom. This suppression of the natural activities of children in the school is one of the most important causes of fatigue noticed so often in children, especially in the lower grades. The practicability of frequent short periods of free play is recognized rather generally. For physiological reasons a still better method of counteracting this undesirable nervous tension is by short rest periods in prescribed positions. Two fifteen-minute rest periods each day are desirable, five-minute periods are better than none. Aim to prevent fatigue, which in children is an important cause of bad

body mechanics. Since muscles never pick up if fatigued, rest in many cases is more beneficial than exercise. The position when resting should be with the child lying upon a flat surface, hands behind neck with elbows touching the flat surface. In this position take at least ten breaths with the mouth closed. We believe that the health of school-children would be really benefited if some



FIG. 8. Lying hyperextension position

space, preferably in the fresh air, could be provided for this purpose.

A more corrective position, and one which is especially helpful for dropped shoulders and hollow chest, is the hyperextension position. (Fig. 8.) A small pillow placed under the back so that its thickest part is under the middle of the dorsal curve will expand the lower ribs. The diaphragm

is raised to the extreme. This position should be continued until the lower ribs have not only been raised, but until they have flared sufficiently to change the costal angle from an acute angle to at least a right angle, if not an obtuse angle. This, at once, assures the space in the upper abdomen under the ribs in which normally the stomach and liver lie. In time this position becomes very restful. The value of rest periods should be appreciated sufficiently to make them part of the school-day program and should be continued over a course of two years or even longer.

III

THE VALUE OF LYING EXERCISES

IN the lying position exercises are taken with a minimum amount of weight bearing. The downward sag of the organs is also relieved. There is practically no resistance against gravity, and without muscular effort the different parts of the body are held in their relatively normal positions. For these reasons when lying it is possible, with the least expenditure of energy, to gain coördination of definite muscle groups which are further developed in the sitting and standing exercises. Emphasis is placed on strengthening the abdominal muscles, rib-stretching exercises, and correct breathing. Lying exercises precede sitting or standing exercises whenever there is lack of sufficient muscle tone to hold the body in the correct upright position or whenever there is improper coördination of the muscle groups. Many times the person with strong, well-built muscles has poor coördination, with the result that the body is incorrectly balanced. In such cases the coördination of the muscles already developed is more valuable than strenuous exercises to gain increased muscle tone. It must be

VALUE OF LYING EXERCISES 33

remembered that exercises do not necessarily mean motion or action, such as running, walking, or even calisthenics. This is particularly true in the development of trunk muscles where the range of motion is so limited.

The following exercises are at first difficult if executed correctly. The amount of action is not great, but the ability to coördinate the trunk muscles is necessary before progressive posture exercises can be given. This type of exercise, both lying and standing, has the same effect of increasing the circulation and respiration as more strenuous exercise. Ten minutes of the proper kind of exercise is more beneficial than an hour of active exercises less carefully chosen.

A precept which teachers find difficult in illustrating, and which many times remains vague in the minds of students, is the consciousness of postural control. There has been furnished a definition of "reflex muscular tonicity" as that slight constant tension which is characteristic of healthy muscles. "Mechanical tension" is a fairly literal meaning. By Dr. Johannes Müller the term "tonus" was employed to denote a certain steady slight contractile tension which he regarded as the characteristic condition of normal skeletal muscles when not engaged in the performance of any specific act. He thought this slight steady tension the outcome of an influence,

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continually imparted from the nerve-centers of cord and brain. Dr. C. S. Sherrington, in his article on "Postural Activity of Muscle and Nerve," states that the condition of constant slight contraction, which is reflex and not conscious action, is confined to those muscles which maintain the animal in an erect position. This reflex postural contraction is characterized by:

1. The low degree of tension it usually develops.
2. The long period for which it is very commonly maintained without obvious fatigue.

Possibly the mild intensity of the contraction maintaining posture is the explanation of the relative immunity from fatigue exhibited by postural as compared with ordinary contraction. In this same article Dr. Sherrington says, "Reflex maintenance and adjustment of posture is a chief portion of the reflex work of the proprioceptive system, just as sensation of a perception of posture is a chief portion of the psychological output of that system."

Beyond this reflex physiological functioning there must be developed a consciousness of control over the voluntary postural muscles. This control is not present at first, but is best gained with practice if the student realizes that definite motor paths must be opened which are present, but which up to this time have not fallen within the conscious control.

IV

SITTING

A GOOD sitting position is as important as the correct erect position when standing, walking, or taking strenuous exercise. For adults who lead a sedentary life as dressmakers, typists, benchworkers, and so forth, it is more important. The correct position in sitting is with the trunk or torso of the body straight, similar to the standing position. Do not lower the ribs; this is always harmful. To keep the normal inclination of the pelvic diameter, sit on the tuberosity of the ischium, not the sacrum. In other words, sit on the hips, not the mid-thighs, with the trunk at right angles to the thighs. A shallow seat is more desirable than a deep seat. When writing at a desk, sit on the forward half of the chair with the feet flat on the floor and knees at right angles. (Figs. 9, 10.)

To hold the trunk in the upright position when sitting, three things must be borne in mind:

1. The normal axial relation of pelvis and thorax.
2. The ribs and chest raised to normal.
3. The head held in its normal position.

In leaning forward the trunk must be kept straight; that is, the pelvis, thorax, and head remain in their relatively normal position. Bend



FIG. 9. Correct sitting position



FIG. 10. Incorrect sitting position

forward and backward with motion only in the hip joint. Keep the chest high. Allow practically no motion in the sacro-lumbar or lumbo-dorsal junctures. (Figs. 11, 12.)

In bending thus, the pelvis moves with the spine as if the spine were not flexible. Fix the

lumbar spine by contracting the abdominal muscles and tightening the gluteal muscles as described in bending when standing. (Page



FIG. 11. Sitting correct
bending forward



FIG. 12. Sitting incorrect
bending forward

90.) An exercise to make this point clear is as follows:

Starting position: Sitting on edge of table —
hands on hips — feet on floor
short distance apart — fix lum-

bar spine by flattening the lumbar curve.

Exercise:

In a rocking motion, using edge of table as a pivot, bend the trunk forward and straighten with flexion only in the hip joint. The pelvis, spine, and chest move as one solid structure.

When sitting, the tendency of the pelvic diameter is to incline downward and backward, directly opposite to the inclination when standing. Bending in the middle, as in leaning over a desk to write, allows the ribs, chest, and head to drop even farther than in a poor standing posture. The abdominal muscles are very relaxed. The head lowered forward with marked round shoulders causes an increased muscular and nervous tension so often described as a congested feeling in the back of the neck. This in time produces general nervous fatigue. The pelvis inclined backward with the chest and head lowered forward many times causes a strain on the sacro-lumbar and lumbo-dorsal joints. Hence the anatomic and physiological changes when sitting incorrectly are greater and have more serious results than those caused by incorrect standing.

A prominent child specialist makes the statement that poor postures in children cause gas, abdominal pains, and chronic constipation. Considering the number of hours each week children sit in school bending over ill-fitting desks, one can readily see the necessity of the correct sitting position throughout their growing years.

To summarize: The three sitting positions are:

1. Upright.
2. Bending forward (working).
3. Bending backward (resting).

In these positions there is no change in the relation of the different parts of the trunk.

Sitting is more restful than standing, because by support of the chair the muscles exert much less energy than in holding the body erect. The heart also works less against gravity.

Before an exercise is taken, here again let us emphasize that for some people it is more difficult to assume the correct sitting position than to take the exercise. In such cases the ability to assume the correct sitting position is more valuable than the exercise. Hence, in certain cases the starting position should be emphasized rather than the exercise.

V

STANDING

Good body mechanics means the correct poise and control of the body with the normal functioning of every organ. The correct position in standing or walking is with the head well back, chin in, the chest raised as if lifted forward-upward, the abdomen flat, and the weight borne chiefly upon the balls of the feet. (Fig. 1.)

“In the erect position the pelvis is placed obliquely with regard to the trunk of the body; the bony ring, which forms the brim of the true pelvis, is placed so as to form an angle of about sixty to sixty-five degrees with the ground on which we stand. In consequence of the obliquity of the pelvis the line of gravity of the head, which passes through the middle of the odontoid process of the axis and through the points of junction of the curves of the vertebral column to the sacro-vertebral angle, descends toward the front of the cavity, so that it bisects a line drawn transversely through the middle of the heads of the thigh bones. And thus the centre of gravity of the head is placed immediately over the heads of the thigh

bones on which the trunk is supported.”¹ (Fig. 13.)

Each person presents a problem in himself, so far as anatomic details are concerned, but for practical purposes we can standardize the correct erect posture, making it applicable to all persons. An habitually correct standing position demands, at first, a conscious control of the trunk muscles which are not commonly used correctly in the daily routine of work. This conscious control is difficult to acquire. It is gained gradually and comes only with constant application. The

arm and leg muscles normally get a great deal of

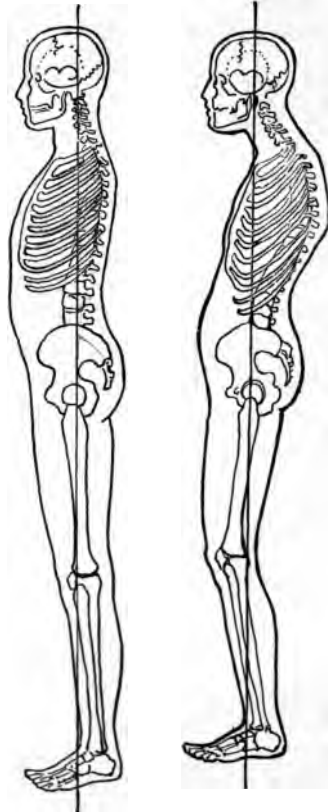


FIG. 13

FIG. 14

FIG. 13. Normal skeleton showing line of gravity. FIG. 14. Outline of skeleton showing relaxed position.

¹ Gray's *Anatomy*.

exercise and should not be overdeveloped, as is often-times done in gymnasium, or, for example, in training acrobats. The mechanical difficulties of the erect position are:

1. Weak muscles.
2. Strained joints.
3. Gravity. (Equilibrium of body is a constant muscle force.)

An important though non-mechanical difficulty is ignorance of correct position.

Systematic training is essential to correct poor posture. Aim to gain two objects:

1. Muscular sense (feel right).
2. Muscular strength (to hold correct position).

Standing is more fatiguing than walking. The muscles and ligaments when standing are put on a continued strain without relief. Even the heart itself is by no means freed from effort in maintaining the erect position. Walking is next most fatiguing because muscles alternately contract and stretch. Walking is good exercise, but there is more fatigue in walking in proportion to effort expended than in any other exercise. Poise is kept chiefly by muscle balance, and undue fatigue should be prevented by avoiding muscle strain

from improper adjustment of different parts of the body.

The muscular coördination gained in the lying exercises forms the foundation and beginning point on which the standing exercises are based. For example, emphasis in the lying exercise is placed on the abdominal muscles. In the standing exercises, emphasis will be made on the proper control of the abdominal muscles plus the simultaneous contraction of the gluteal muscles. First consider the skeleton, later the control of definite muscle groups. The normal spine is a flexible rod bent in three curves in the antero-posterior plane, convex forward in the cervical and lumbar regions, convex backward in the dorsal region. These curves develop with age and become fixed. Muscle relaxation causes three variations in these curves. (Fig. 14.)

- Cervical 1. Forward shoulders — the displacement of the shoulder girdle.
- Dorsal 2. Round back — increase in dorsal curve with which is always associated displacement of shoulder girdle.
- Lumbar 3. Round hollow back — increase in both dorsal and lumbar curves — commonly designated by term "sway-back."

Starting from these as keynotes, the spine has four weak points at which motion occurs. They are:

1. Sacro-lumbar juncture.
2. Lumbo-dorsal juncture.
3. Dorso-cervical juncture.
4. Atlanto-occipital juncture.

The segments of the spine between these junctures have a definite relation to each other in their arc of motion, and when in their proper relation the body is so well poised that the muscle groups are pulling equally on all sides. When relaxation occurs the tendency is to give way in one or more of these junctures.

Joints are held in place by muscles and ligaments. If the muscles are not brought properly into play, the ligaments soon become strained and form a poor support for the joint. When ligaments are strained, they lose their elasticity and there occurs not only a change in the relationship between the bones, but also a marked change in the muscle tone. By "muscle tone" is meant the certain amount of muscular contraction demanded at all times without which the body would collapse. On the other hand, through the acquirements of conscious muscular control these joints and segments can be held in their proper

relation and the strain on joints and ligaments avoided.

If the three curves in the spine are normal the spinal segments are in their proper relation and the weight-bearing line is normal. If one or more curves are increased, the segments are out of their proper relation and the weight-bearing line is not true. The farther one gets away from the normal weight-bearing, the greater is the instability of the spine. In giving exercises for general development, or even corrective exercises, the spine should be considered as a whole. For explanation, however, the three curves will be considered separately.

LUMBAR CURVE

For physiological and anatomical reasons it is important to prevent an increased lumbar curve. An increase in the lumbar curve is associated with an increase in the pelvic inclination. A flattening of the lumbar curve is associated with a diminished pelvic inclination. (Figs. 15, 16.) The normal inclination of the pelvis is important because with every variation from the normal of the body in the upright position, the pelvic inclination must vary. An increased lumbar curve causes:

1. A forward-downward tipping of the pelvic diameter, which in turn interferes with the

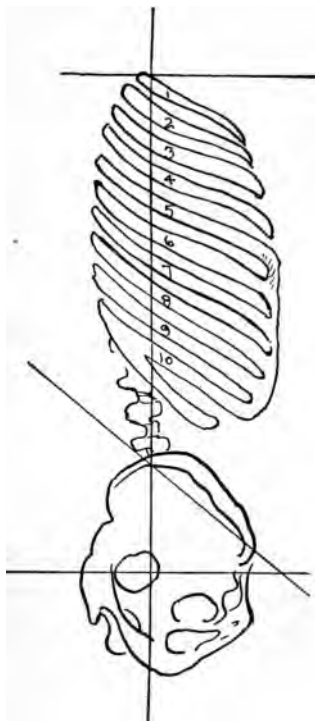


FIG. 15. Normal rib and pelvic inclination

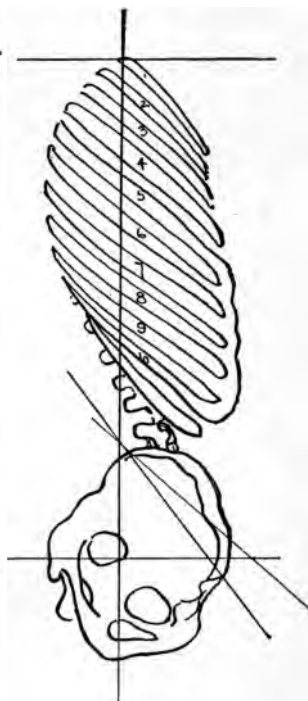


FIG. 16. Abnormal rib and pelvic inclination

normal function of the pelvic and abdominal organs.

2. A strain on the sacro-lumbar and sacro-iliac joints.

3. General poor posture resulting in the "sway-back type" with sunken chest, head forward, protruding abdomen, with body weight falling on the heels.

An exercise to decrease the lumbar curve is the abdominal retraction exercise as follows:

Starting position: Hands at side — stand with heels four inches from wall; hips, shoulders, head, touching the wall.

Exercise: Flatten the lumbar spine against the wall by simultaneously contracting the abdominal and gluteal muscles. The pelvis rotates through the hip joints.

Explanation: Tightening the abdominal and gluteal muscles tends to draw the buttocks down and the coccyx slightly forward. Keep the buttocks against the wall. (Figs. 17, 18.)

DORSAL CURVE

An increased dorsal curve results in the "round back type," which is hard to correct because of the stiffness of the dorsal spine due to the ribs.

attachments. The dorsal spine is also affected by the position of the chest. (Fig. 14 — note



FIG. 17

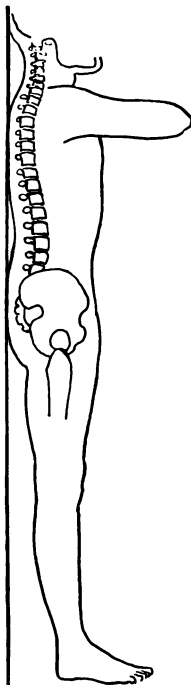


FIG. 18

FIG. 17. Skeleton showing abdominal retraction exercise. FIG. 18. Skeleton showing abdominal retraction exercise with lumbar curve flattened

downward inclination of the ribs.) The stomach and liver cannot work rightly if the ribs are contracted and narrowed so that there is practically no subdiaphragmatic space. Many times the ribs are narrowed at the bottom, producing an acute angle at the border of the costal cartilages at the xiphoid. Rib-stretching and hanging exercises must be continued until the lower ribs have

not only been raised, but until they have flared sufficiently actually to bring about a perma-

ment widening of the costal angle. The normal position of the ribs is one of the most important factors in gaining the correct posture, because the position and flexibility of the ribs somewhat determines the flexibility of the dorsal spine. With the ribs lowered in front there is imperfect support for the shoulders, so that they are drooped forward, the scapulæ being rotated outward at the top, so that their long axis is much more oblique than normal. Exercises designed to affect the dorsal spine should aim first for flexibility; secondly, for correction. Flexibility is best gained by using bi-lateral exercises. The lying hyperextension position (page 30) is of value in correcting this curve even before exercises are begun.

An example of rib-stretching exercises is as follows:

Starting position: Good standing position — hands on head.

Exercise: . Raise one shoulder elevating ribs on one side — repeat same on opposite side — then raise shoulders simultaneously to raise ribs on both sides. (Figs. 19, 20.)

CERVICAL CURVE

The normal physiological curve at the cervical-dorsal region cannot be maintained if the head is carried forward. The position of the head is im-



FIG. 19. Rib-stretching exercise



FIG. 20. Rib-stretching exercise — side view

portant because of its influence on the shoulders and chest. The shoulders will correct themselves if the ribs, chest, and head are held in their nor-

3. General poor posture resulting in the "sway-back type" with sunken chest, head forward, protruding abdomen, with body weight falling on the heels.

An exercise to decrease the lumbar curve is the abdominal retraction exercise as follows:

Starting position: Hands at side — stand with heels four inches from wall; hips, shoulders, head, touching the wall.

Exercise: Flatten the lumbar spine against the wall by simultaneously contracting the abdominal and gluteal muscles. The pelvis rotates through the hip joints.

Explanation: Tightening the abdominal and gluteal muscles tends to draw the buttocks down and the coccyx slightly forward. Keep the buttocks against the wall. (Figs. 17, 18.)

DORSAL CURVE

An increased dorsal curve results in the "round back type," which is hard to correct because of the stiffness of the dorsal spine due to the ribs

attachments. The dorsal spine is also affected by the position of the chest. (Fig. 14 — note

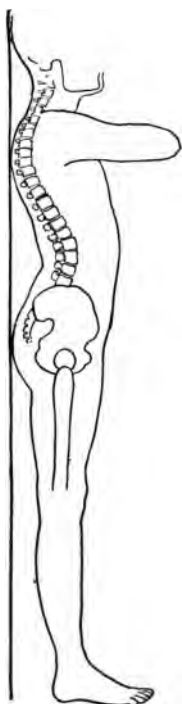


FIG. 17



FIG. 18

FIG. 17. Skeleton showing abdominal retraction exercise. FIG. 18. Skeleton showing abdominal retraction exercise with lumbar curve flattened

downward inclination of the ribs.) The stomach and liver cannot work rightly if the ribs are contracted and narrowed so that there is practically no subdiaphragmatic space. Many times the ribs are narrowed at the bottom, producing an acute angle at the border of the costal cartilages at the xiphoid. Rib-stretching and hanging exercises

must be continued until the lower ribs have

not only been raised, but until they have flared sufficiently actually to bring about a perma-

For example: Flatten the lumbar spine (page 47); then raise the ribs as emphasized on page 49. Stretching tall, walk on tiptoe on a straight line. While taking this exercise one is conscious of an upward stretch of the spine, particularly through the dorsal region. In this position the weight of the strain of carrying the superimposed segments of the body is taken off the lower spine and the line of gravity of the body falls on the balls of the feet. If this same weight-bearing line is maintained when walking ordinarily, there exists the sensation of springing slightly each step, and the body moves steadily forward rather than swaying from side to side with a heavy tread caused by the weight falling on the heels.

“In the upright position, the poise or attitude in which there is the least strain, and consequently the correct attitude, is with the body held so that it is made as tall as is possible without rising on the toes. In this position the head is erect, the shoulders are carried so that their center is distinctly posterior to the center of gravity, the chest is high, the abdomen is flat, and the spinal curves are slightly convex backward in the dorsal region and convex forward in the lumbar region. The pelvis is inclined forward so that the axis from the promontory of the sacrum to the top of the pubic bone is downward and forward thirty

degrees from the horizontal, the inclination of the sacrum being downward and backward so that the axis of the pelvis is at right angles with the plane of the brim of the pelvis, or about sixty degrees from the horizontal. In this position the anterior portion of the upper part of the sacrum, together with the last lumbar vertebra, is almost directly over the top of the great trochanter, or a little posterior to the center of the hip joint. In this position the Y ligament is made tense as well as the iliopsoas muscle, these two structures serving to prevent the pelvis from lessening its forward inclination. In this position the hamstring muscles are tight, giving support to the knees as well as preventing an increase in the forward inclination of the pelvis. The knees are straight and the weight is received at the foot upon the astragalus with the posterior calf muscles tight, so that the heel rests lightly and the chief strain is thrown upon the ball of the foot. The posterior calf muscles are tense, the result being that the posterior tibial and peroneus longus by their contraction hold the tarsal bones in place, the foot thus being in the position of greatest strength, while the flexor muscles of the toes hold them in contact with the floor, giving a stable base and rendering the forward propulsion of the body possible with the least effort.

“The muscles of the trunk in this position are in such balance that while the anterior and posterior groups are in slight contraction, neither group is strained and but few of the ligaments are under tension. The shoulder is slightly back of the lateral median line of the body so that the weight is received largely upon the thorax, none of the muscles being in more than slight contraction, and the strain upon the posterior muscles which must occur when the shoulder is held forward is absent. The head is held erect and so balanced that while all of the muscles, the anterior, posterior, and lateral, are in slight contraction, each group is properly balanced by the others and none are subjected to more work than they can easily perform. With the body so poised, not only is there the least possible expenditure of energy required for the maintenance of the position, but it is from this position that action is made most easily. All of the parts are in balance, so that whatever the movement, whether it concern chiefly one part or another, the start is made with no waste of energy in correcting the poise or ‘gathering one’s self’ preparatory to the action.”

The following exercises develop a sense of co-ordination and strengthen the trunk muscles. They are designed to —

1. Elevate the chest.

Starting from these as keynotes, the spine has four weak points at which motion occurs. They are:

1. Sacro-lumbar juncture.
2. Lumbo-dorsal juncture.
3. Dorso-cervical juncture.
4. Atlanto-occipital juncture.

The segments of the spine between these junctures have a definite relation to each other in their arc of motion, and when in their proper relation the body is so well poised that the muscle groups are pulling equally on all sides. When relaxation occurs the tendency is to give way in one or more of these junctures.

Joints are held in place by muscles and ligaments. If the muscles are not brought properly into play, the ligaments soon become strained and form a poor support for the joint. When ligaments are strained, they lose their elasticity and there occurs not only a change in the relationship between the bones, but also a marked change in the muscle tone. By "muscle tone" is meant the certain amount of muscular contraction demanded at all times without which the body would collapse. On the other hand, through the acquirements of conscious muscular control these *joints* and segments can be held in their proper

relation and the strain on joints and ligaments avoided.

If the three curves in the spine are normal the spinal segments are in their proper relation and the weight-bearing line is normal. If one or more curves are increased, the segments are out of their proper relation and the weight-bearing line is not true. The farther one gets away from the normal weight-bearing, the greater is the instability of the spine. In giving exercises for general development, or even corrective exercises, the spine should be considered as a whole. For explanation, however, the three curves will be considered separately.

LUMBAR CURVE

For physiological and anatomical reasons it is important to prevent an increased lumbar curve. An increase in the lumbar curve is associated with an increase in the pelvic inclination. A flattening of the lumbar curve is associated with a diminished pelvic inclination. (Figs. 15, 16.) The normal inclination of the pelvis is important because with every variation from the normal of the body in the upright position, the pelvic inclination must vary. An increased lumbar curve causes:

(Fig. 22.) The round-shouldered child needs no introduction to teachers. To show that this condition is more nearly associated with the general attitude of the body than with simply a departure from the normal shoulder girdle, we quote the following from Dr. Robert W. Lovett's book on round shoulders:¹ "In general the attitude is familiar, the head is carried forward and is somewhat flexed, the physiological curve in the dorsal region is increased and the dorsal region unduly prominent behind, in which backward curve the lumbar region may share, or there may be also an increased lumbar curve forward. The shoulders are drooping and the chest narrow and flat, while the scapulæ behind are prominent in their posterior borders and the inferior angles may stick out markedly (*scapulæ alatæ*). The abdomen is prominent and the pelvic inclination varies. Flatfoot or pronated foot frequently coexists." Round shoulders may be postural or structural. Postural round shoulders is the type which lies within our ability to prevent and correct.

The muscular development of children with round shoulders is usually below par; hence posture or any condition which results in the forward

¹ Dr. Robert W. Lovett, *Lateral Curvatures of the Spine and Round Shoulders*.

inclination of the body would increase the tendency of the shoulders to drag forward, even more than in healthier children, and consequently increase the strain on the posterior muscles. If this strain is continued, the back muscles become weaker, allowing greater increase in the dorsal curve with a compensatory increase in the lumbar curve. Hence the body assumes an attitude which is far from the normal balance or poise. We now have a disturbance from the feet upward which can be changed only by the correction of the feet, spinal, and shoulder positions at the same time. In fact, if the normal relation between the feet, spine, thorax, and head exists, the round shoulders will as nearly approach their normal positions as is possible by self-correction.

In some cases of round shoulders, not only do the pectoral muscles contract, but also the serratus muscles, in which case the rib-stretching exercises are of great value. The lying hyper-extension position is excellent for such cases. What has been said in Chapter V ("Standing") applies equally as well to the correction of postural round shoulders. In both the correction of a faulty attitude is essential. Exercises especially adapted for the correction of round shoulders have been designated. We feel certain that if the work under Chapter V ("Standing") were car-

ried out during childhood, the problem of round shoulders would be reduced to a minimum.

The present method of supporting a child's clothing by a loose waist, which transfers the weight of the clothes (sometimes as heavy as four pounds) to the movable tips of the shoulder, is conducive to round shoulders. The remedy is found in a waist in which the pull comes at the base of the neck instead of at the tips of the shoulders.

VII

FEET

FAULTY weight-bearing is a national problem. Flat-footedness was a prevalent cause for unfitness in the army and it is an important problem in civilian life as well. One factory of ready-made arch supporters claims to sell three thousand pairs each month to shoe-stores. This shows a demand by the public. Seventy-seven per cent of the undergraduates at Wellesley College have faulty weight-bearing lines. American public schools show the same large percentage. This is an important question in relation to the efficiency of the race, that should be attacked in public schools. The problem of the physical director is to prevent foot strain, weak feet, and flat feet rather than seek a cure. The end to be worked for is the habitually correct mechanical use of the feet.

“The foot has two arches formed by small bones and maintained by ligaments and muscles.

1. Longitudinal arch.
2. Transverse or anterior arch.

Neither arch has any true keystone and will fall of its own weight if not held by ligament

muscles. The sustentaculum tali is a prop on the inner side of the os calcis which prevents most feet from pronation. Muscular anatomy is the most important factor in maintaining proper weight-bearing lines. Muscles controlling the position of the foot are in three groups:

1. Adductors — determining relation of astragalus to os calcis.
 - a. Anterior tibial.
 - b. Posterior tibial.
 - c. Flexor longus hallucis.
 - d. Flexor longus digitorum.
2. Abductors — tending to turn out and depress long arch.
 - a. Peroneus longus.
 - b. Peroneus brevis.
 - c. Peroneus tertius.
3. Intrinsic muscles — bow strings to long and transverse arch.
 - a. Flexor brevis.
 - b. Muscles of anterior arch.

Any improper relation of strength of these muscle groups causes potential foot-strain. The principal causes of foot-strain are as follows:

1. Increase of weight.
2. Changes of occupation — demand more hours on feet.

3. Acute illness — weight-bearing suddenly ceased and suddenly begins.
4. Debility from chronic illnesses and nervous overtire.
5. Stretching of ligaments supporting arch (not due to diminished constitution, but to faulty attitudes, improper gait, lack of muscle balance, deforming shoes).

The relation of foot skeleton to leg skeleton is such that, uninfluenced by ligaments and muscle pulls, the normal line of weight-bearing falls on the inner side of the foot and tends to depress the longitudinal arch.”¹ Hence any exercise which aims to raise the arch by strengthening the intrinsic muscles and roll the weight on the outer border of the foot is beneficial.

“The astragalus receives the weight of the body and the os calcis is fixed by its position on the ground; therefore, any change in the weight-bearing line must be controlled by the relation of the astragalus to the os calcis. Strain is most commonly seen when os calcis and astragalus change relation. Strain can be detected by tenderness on the calcaneo-scaphoid ligament. There is no relation between the height of the arch and strength of the foot.

¹ Dr. Robert B. Osgood, *Pathologic and Symptomatic Weight-Bearing — A Consideration of the Prevention and Cure of Foot-Strain*.

“Because of the bony and muscular anatomy, the foot has difficulty in maintaining its proper mechanics. If the abductor group of muscles is stronger than the adductor, toeing outward is favored. The weight-bearing line falling to the inner side of the foot favors pronation. Any contraction of the tendo Achillis induces a valgus position, and a shortened tendo Achillis favors foot-strain.”

There is, however, a certain muscle balance which must be worked for or maintained. The adductor group should always be stronger than the abductor. This is best accomplished by the type of exercises which follow. There is, without question, an intimate connection between flat feet, debility, and visceroptosis.

High heels have always received well-merited censure. The hyperextension of the feet compels the trunk to be thrown back while the knees are slightly flexed. It has been proven when walking in high heels there is comparative inaction of the muscles of the legs and feet. This results in less nutrition and less perfect circulation through the legs and feet. High heels upset the architectural balance of the feet and legs and the effect of the incorrect attitude is felt in the spine and pelvis. High heels induce and aggravate lordosis. They may temporarily relieve strain of

the longitudinal arch, but by thrusting the weight forward on to the heads of the metatarsals they cause eventually flattening of the anterior arch.

VIII

TYPES

LET us again emphasize that in practically all cases primarily the general development working for the proper relation between the different parts

of the body is most important. Exercises concentrating on one particular deformity are secondary. These secondary exercises should follow after a week or two of exercise for general development. The kind of secondary exercises depends upon the type of person under consideration. From a developmental point of view the human race falls into three types, each possessing characteristics peculiar to its type.



FIG. 21. Normal type

1. Normal human type.
2. Slender or congenital visceroptotic type.
3. Heavy or herbivorous type.

The extremes of two of these types are recognized

by all. The heavy type with shoulders broad and square, the skeleton large, with muscles strongly built, the joints less flexible and the spinal motion less free than the normal type. In contrast to this is the slender type with slight figure, the long,



FIG. 22. Thin type



FIG. 23. Heavy type

narrow trunk, muscles slender, and marked flexibility throughout the body. There is also the intermediate normal type.

Because of the difference in anatomic structure, each type has potentials of certain abnormalities.

For example: The formation of the vertebræ of the slender type is different from that of the heavy type. (Figs. 24, 25.) The normal type falls midway between these two. To emphasize an important point, we find in the slender type



FIG. 24. Thin type showing slender back



FIG. 25. Heavy type showing broad back

that the spine is smaller in size than the normal and the lumbar vertebræ are like the so-called normal dorsal vertebræ in shape, the body being of about the same width laterally as it is deep

antero-posteriorly. Occasionally one may find even six vertebræ in the lumbar region with the full number of sacral vertebræ, and in these cases this is one of the reasons for the greater proportionate length of the body. The articular processes tend to be of the flat (not crescentic) type. Because of this formation, the lumbar spine is much more flexible than the normal type. It is this anatomic type from which the fancy dancer, the hurdlers, and the acrobat are developed.

In the heavy type the spine is broad and heavy throughout, but in the lumbar region this is especially noticeable. The lumbar region is short, and here we may occasionally find only four lumbar vertebræ, and also because the sacrum is set well down between the wings of the ilia. The lateral diameter of the vertebral bodies in this region is considerably greater than the antero-posterior, the articular processes are strong and large and almost always of the crescentic type. The transverse processes are long and broad, and the last lumbar frequently forms an articulation with the sacrum. It is this anatomic type from which the heavy football players are chosen and men suited for hammer-throwing and shot-putting.

Because of this formation of the lumbar verte-

bræ the slender type has a tendency greatly to increase the lumbar curve with increase in the pelvic inclination. Therefore the slender type needs emphasis on the pelvic tilt. In the heavy type the weak point is found at the dorso-lumbar joint, in which case rib-stretching and chest-raising exercises are more important than flattening the low back.

The slender spine is more flexible, the joints more loosely held together, and the thin slight muscles not so well adapted to form the proper support as in the heavy type with strong, firm muscles and thickset joints. Therefore, a greater number of weak backs and greater increased curves occur in the slender type than in the heavy type.

Backaches are many times caused by an overriding and impingement of the spinous processes due to hyperextension of the spine when standing. (Fig. 17.) This in not too severe cases may be corrected by flattening the lumbar spine, thus separating these processes and making the increased curve more nearly approach the normal. (Fig. 18.) An exercise to accomplish this is the abdominal retraction. (Page 47.)

Because of the clinical significance of viscerop-tosis and because the majority of children fall within this so-called carni s. a

detailed study of this type is necessary. Statistics show that sixty per cent of the high-school boys of Worcester were of this class, and as a class they represented bad posture, poor muscles, poor nutrition, poor teeth, prominent abdomens, and ptosis.

Dr. Robert B. Osgood pictures concisely the visceroptotic. To quote:¹ "Congenital in its nature, associated in a large percentage of cases, as Dr. Bryant's autopsy records prove, with a narrow chest, abdominal intestinal adhesions, and probably frequently with ilial stasis, it is a recognizable anatomical fact. The stomach is small and low, J-shaped, and far to the left. The liver is small and low, vertical and far to the right. The small intestine is small and short, fifteen to twenty feet or less. The colon is long with a low hepatic flexure, a high splenic flexure, and the transverse portion with a long, low loop, probably with a long mesentery. There is a typical posture and relaxed abdominal wall." (Fig. 22.)

Dr. Bryant's records prove that these individuals are strikingly susceptible to tuberculosis, insanity, pellagra, leprosy, and carcinoma, and he suggests that the position of the viscera may

¹ Dr. Robert B. Osgood, "What Evidence can be brought forward to show that Visceroptosis is anything more than a Variation from the Anatomic Norm and is of frequent Causative Clinical Significance?"

account in part for this susceptibility, and that these five diseases seem to be diseases due probably primarily to faulty nutrition. Despite the varied opinions of doctors as to the cause of or best means of relieving visceroptosis, one interesting fact is noted. In every instance some mention is made of the relation between this condition and mechanical defects.

Dr. Osgood further states that "Definite types of posture and relaxed abdominal walls must favor a sagging of the viscera. It would surely seem that derangements of this sort must predispose in time to faulty action of the viscera, since mechanical conditions are altered, and altered in ways which do not suggest more favorable action or improved function."

Dr. James Warren Sever, in a study to determine the location of the stomach in relation to posture, draws the conclusion that neither poor posture nor impaired general health are causes of ptosis. He mentions, "In treating such cases, nevertheless, it is obvious that poor posture should be corrected, and impaired general health built up."

Dr. John Bryant writes: "It seems evident that this problem of posture should be attacked during the child's period of growth since after study along this line it becomes evident that the same

developmental peculiarities found in adults can also be demonstrated in children. Hence the primary problem lies not in the adult, but in the child." The treatment of ptosis, Dr. Bryant claims, is essentially non-surgical, and "any approach to a cure is only reached through weeks and months of medical or orthopedic care during which body form must be altered, posture corrected, and diet regulated to stimulate a natural organotherapy."

To emphasize the importance of the mechanical readjustment, we have quoted from a few of the leading doctors who have spent much time in study along this line. It seems obvious that not only is this postural work important in such cases, but fundamentally the principle applies as well to all children of all types. To what higher ideal can our physical educators aspire than to aim to prevent future illness in the hope that the children of our country may live healthier and happier lives?

IX

CONCLUSION

PHYSICAL education should be founded on the principles of body mechanics if the highest degrees of health and efficiency are to be attained. In order to make this possible there must be a change in the present program or day's order of the typical gymnastic lesson.

At first it may seem radical, but not too radical, it is hoped, to suggest that the lesson is quite complete if divided into two parts:

1. Formal exercises. Aiming especially to develop trunk muscles.
2. Game. Allowing recreation, freedom of motion, and relaxation.

The value of educational gymnastics, dancing, athletics, and sports of all kinds is fully appreciated, but such exercise should not be carried on at the expense, or in many cases to the total neglect of more fundamental development. This fundamental development is now understood to mean the acquiring of good habits of correct body mechanics.

X

PROGRESSIVE EXERCISES

I. Chest-Breathing

No attempt has been made to compile a complete list of exercises for any group or groups of muscles. Fundamental exercises only are here described, but many more difficult exercises can readily be given after these are accomplished.

Progression in the following exercises is made by a change in the starting position.

EXERCISE I

Starting position: Lying — hands behind neck — elbows on table — raise chest and hold chest high while breathing deeply.

Exercise: Inhale and relax upper abdominal muscles; exhale by contracting abdominal muscles.

Explanation: Since the diaphragm and the anterior abdominal walls should coördinate their action through the respiratory center, the contraction of the diaphragm and relaxation of the upper anterior

abdominal muscles should occur together, the abdominal wall being pushed outward by the pressure of the diaphragm transmitted through the abdomen. At expiration, by contraction of the upper abdominal muscles the intra-abdominal pressure is transmitted to the diaphragm, stimulating it to relax.

EXERCISE II

Starting position: Sitting—hands on hips—raise chest high and hold chest high while breathing deeply.

Exercise: Inhale and relax upper abdominal muscles; exhale by contracting abdominal muscles.

Explanation: See Exercise I.

EXERCISE III

Starting position: Standing—hands on hips—raise chest high and hold chest high while breathing deeply.

Exercise: Inhale and relax upper abdominal muscles; exhale by contracting abdominal muscles.

Explanation: See Exercise I.

EXERCISE IV

Starting position: Hands behind neck — raise chest high and hold chest high while breathing deeply.

Exercise: Inhale and relax upper abdominal muscles, exhale by contracting abdominal muscles.

Explanation: See Exercise I.

EXERCISE V

Starting position: Standing — hands at side.

Exercise: Rising on toes, raise the arms forward-upward (angle 45 degrees) and inhale; lower the heels and arms and exhale.

Explanation: When the arms are raised the body should be in the same position as tall walk exercise (page 85). In this position the diaphragm works to the best possible advantage. This exercise is supposed to be distinctly beneficial in increasing the circulation of the legs and deep abdominal veins. It is of value in cases of varicose veins.

2. Abdominal Retraction

EXERCISE I

Starting position: Lying — hands at sides — knees bent — feet resting on table.

Exercise: Flatten the lumbar spine against the table by contracting the abdominal muscles.

Explanation: To flatten the lumbar spine the inclination of the pelvis must be diminished. By contracting the abdominal muscles thus straightening the lumbar curve against the table, the whole pelvis rolls so that the end of the spine (coccyx) is raised slightly from the table. The pelvis rotates through the hip joint. Do not put weight on the feet. This is a strong abdominal exercise and develops the ability to diminish the pelvic inclination and leads to the accomplishment of a similar exercise when standing.

EXERCISE II

Starting position: Sitting — hands on hips — feet flat on floor.

Exercise: Straighten the lumbar curve by contracting the abdominal and gluteal muscles; relax abdominal muscles.

Explanation: This is a strong abdominal exercise. With the lumbar curve practically straightened when sitting the pelvis is held at its correct angle and the trunk is at right angles to the thighs.

EXERCISE III

Starting position: (Figs. 26-27.) Stand with heels four inches from the wall — hips, shoulders, head, touching wall — hands at side.

Exercise: Straighten the lumbar curve against the wall by contracting the abdominal and gluteal muscles.

Explanation. Emphasis is placed on the strong contraction of the abdominal and gluteal muscles

which tend to draw the buttock down and the coccyx slightly forward. Keep the buttocks



FIG. 26. Abdominal retraction exercise



FIG. 27. Abdominal retraction exercise with lumbar curve flattened

against the wall. The ilio-psoas muscles are contracted when the pelvis is held in this position.

EXERCISE IV

Starting position: Standing, hands at sides — flatten the lumbar curve as described in Exercise III.

Exercise: Hold this position while walking forward.

Explanation: The pelvis is held at its correct inclination; hence the lumbar curve is normal. With the chest raised forward-upward, the lower spine is relieved of the strain of carrying the superimposed body segments. This is, for the majority of the people, a most important postural corrective exercise.

EXERCISE V

Starting position: Lying — hands back of neck — knees straight — flatten the lumbar curve against the table by contracting the abdominal muscles and rolling the pelvis as described in the lying abdominal retraction exercise. (Page 78.)

Exercise: Bend one knee over chest;

straighten leg upward; lower slowly, keeping knee straight and back flat against table. Alternate.

Explanation: This is a strong abdominal exercise. The abdominal muscles are brought into play not only by the leg action, but also in an attempt to hold the pelvis in this position.

EXERCISE VI

Starting position: Lying — hands back of the neck — knees straight. Flatten the lumbar curve against the table by contracting the abdominal muscles and rolling the pelvis as described in the lying abdominal retraction exercise. (Page 78.)

Exercise: Raise leg; lower slowly keeping back flat. Alternate.

Explanation: This is a strong abdominal exercise, involving all the abdominal muscles.

EXERCISE VII

Starting Position: Lying — hands behind back

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—flatten the lumbar spine against the table by contracting the abdominal muscles and rolling the pelvis as described in the lying abdominal retraction exercise. (Page 78.)

Exercise: Raise one leg; lower slowly six times, keeping back flat. Alternate.

Explanation: This exercise involves all the abdominal muscles.

EXERCISE VIII

Starting position: Lying — hands at sides — flatten the back against the table by contracting the abdominal muscles and rolling the pelvis as described in the lying abdominal retraction exercise. (Page 78.)

Exercise: Bend both knees over chest — straighten legs upward; lower slowly one-half distance to table, then bend knees — keeping back flat against table.

Explanation: This exercise defeats its purpose if the lumbar spine is allowed to curve while the legs are being lowered.

EXERCISE IX

Starting position: Sitting on floor — knees straight — hips — shoulders — head touching wall — flatten the lumbar spine against wall.

Exercise: Raise one leg; lower; then raise other leg; lower.

Explanation: The abdominal muscles are brought into play in the attempt to hold the back flattened against the wall. In this position, alternate leg raising is extremely difficult.

3. Tall Walk

EXERCISE I

Starting position: Standing — hands behind neck — flatten the lumbar curve as described in abdominal retraction exercise. (Page 79.)

Exercise: Hold this position while walking on tiptoe on straight line.

Explanation: The added upward stretch of the ribs and dorsal spine, because of change in position of the hands makes this a much more difficult exercise than

simple abdominal retraction. Walking on tiptoe is helpful in some cases in gaining a conscious contraction of the gluteal muscles.



FIG. 28. Correct tall walk



FIG. 29. Incorrect tall walk

EXERCISE II

Starting position: (Figs. 28 and 29.) Stretch arms forward-upward as in

reaching; contract the abdominal and gluteal muscles, thus flattening the back — stretch up chest and ribs — head up, chin in.

Exercise:

Walk on tiptoes on line.

Explanation:

The anterior abdominal muscles are strongly contracted; flattening the lumbar curve lengthens the spine, thus bringing into play the balancing mechanism of back muscles, especially in the lumbar region; namely the low fibres of the erector spinæ, the quadratus lumborum and latissimus dorsi. Emphasis should be placed on stretching the arms forward-upward at an angle of 45 degrees. This greatly elevates the ribs, stretching the intercostal and upper back muscles. The diaphragm is lifted, making room for the viscera which are being drawn in and up by the contraction of the anterior abdominal muscles. Walking on tiptoe brings in the element of balance. The arms

should not be stretched directly upward because in this position the tendency is to increase the lumbar curve.

EXERCISE III

Starting position: Stretch arms forward-upward as if reaching; contract the abdominal and gluteal muscles flattening the back, stretch up chest and ribs — head up — chin in.

Exercise: Bend one knee upward — straighten leg forward — step. Bend other knee — straighten leg forward — step.

Explanation. See Exercise II. This is a difficult balance exercise. It is known as the “turkey walk.”

4. Rib-Stretching

EXERCISE I

Starting position: Lying — hands at sides.

Exercise: Raise one shoulder elevating ribs and stretching intercostal muscles on one side; repeat same on opposite side; then raise both shoulders elevating ribs as much as possible.

Explanation: Stretching the ribs helps to gain flexibility in the dorsal spine, which is necessary before progress can be made in standing exercises. Spreading the lower ribs increases the intercostal angle, which is an important factor in lessening the inclination of the ribs when standing. Rib-stretching exercises are of great value, and if practiced correctly will increase the antero-posterior and lateral diameters of the thorax.

EXERCISE II

Starting position: Lying — raise arms over head and grasp end of table — flatten the lower back by contracting the abdominal muscles.

Exercise: Pull on one arm sufficiently to feel an upward stretch on ribs and through the dorsal spine. Repeat same on opposite side, then pull equally on both arms to stretch ribs simultaneously on both sides.

Explanation: See Exercise I.

EXERCISE III

Starting position: Sitting — hands on head.

Exercise: Raise one shoulder elevating ribs on one side; repeat same on opposite side; then raise shoulders equally to elevate ribs simultaneously on both sides.

Explanation: See Exercise I.

EXERCISE IV

Starting position: Standing — hands behind neck.

Exercise: Raise one shoulder elevating ribs on one side; repeat same on opposite side; then raise shoulders equally to elevate ribs simultaneously on both sides.

Explanation: See Exercise I. (Figs. 19 and 20.)

5. Trunk-Bending

EXERCISE I

Starting position: Sitting on forward half of chair — hands on hips — feet flat on floor — straighten the lumbar curve.

Exercise: Bend trunk forward.

Explanation: To bend the trunk forward, the

pelvis rotates through the hip joint. By holding the lumbar curve fixed, there is practically no motion in this region. When bending in the hip joint the relative position of the pelvis, thorax, and spine is not changed. In other words, the pelvis, thorax, and spine move as one solid structure. Bending forward as described prevents motion at the lumbo-sacral joint, which many times is the weakest point in the spine and where no motion should take place. (See Figs. 11 and 12.)

EXERCISE II

Starting position: Standing — hands on hips —
— straighten the lumbar curve.

Exercise: Bend the trunk forward.

Explanation: When straightening the trunk the gluteal muscles must be strongly contracted in order to hold the pelvis in its correct relation to the trunk. See Exercise I. (See Figs. 30 and 31.)

EXERCISE III

Starting position: Standing — hands behind neck
— straighten the lumbar curve.

Exercise: Bend the trunk forward.



FIG. 30
Correct forward bend



FIG. 31
Incorrect forward bend

Explanation: If emphasis is placed on the upward stretch of the ribs because of change in the position of the

hands, this exercise is much more difficult than Exercise II.

EXERCISE IV

Starting position: Standing — stretch arms forward-upward — flatten the lumbar curve — head up — chin in — chest up.

Exercise: Bend the trunk forward.

Explanation: The starting position is similar to the tall walk exercise. (Page 85.)

6. Lateral Abdominal Contraction

EXERCISE I

Starting position: Lying — hands at sides.

Exercise: Raise one shoulder spreading ribs apart — hold this upward stretch position and then contract side abdominal muscles. Alternate.

Explanation: Hold the upward stretch position, then contract side abdominal muscles as if pulling the hip up to the ribs. By spreading the ribs apart the intercostal muscles are stretched. The coördination of the lateral ab-

dominal muscles is at first hard to gain, but when proficiency in this exercise is obtained, there is a decided contraction of the transversalis. This exercise is of value in strengthening the lateral abdominal wall and making the dorsal spine flexible by raising the ribs.

EXERCISE II

Starting position: Lying — hands behind neck.

Exercise: Raise one hip by a strong contraction of the side abdominal muscles. Alternate.

Explanation: There is little motion in this exercise, but the whole pelvis is raised diagonally upward on one side, then the other side. Strengthening the lateral abdominal muscles is as important as developing the anterior abdominal muscles.

EXERCISE III

Starting position: Sitting — hands on head.

Exercise: Raise one shoulder elevating ribs — hold this upward stretch

position and then contract side abdominal muscles. Alternate.

Explanation: See Exercise I.

EXERCISE IV

Starting position: Standing — hands at sides.

Exercise: Raise one shoulder elevating ribs — hold this upward stretch position and then contract side abdominal muscles. Alternate.

Explanation: See Exercise I.

EXERCISE V

Starting position: Standing — hands behind neck.

Exercise: Raise one shoulder elevating ribs — hold this upward stretch position and then contract side abdominal muscles. Alternate.

Explanation: The added upward stretch of the ribs and dorsal spine because of the position of the hands makes this exercise much more difficult than Exercise IV.

EXERCISE VI

Starting position: Lying on right side — stretch arms forward shoulder high — flatten the lumbar curve by

contracting the abdominal and gluteal muscles. Raise right leg upward — lower — repeat same on opposite side.

Explanation: With the pelvis held in this position the contraction of the side abdominal muscles is easily detected because these, with the tensor fascia femoris and glutei, are the muscles brought into play when the leg is raised.

EXERCISE VII

Starting position: Lie over edge of table face down — feet on floor — stretch arms over head and grasp sides of table — raise legs backward on level of spine — heels together.

Exercise: Carry legs to right — then left — continue alternating sides.

Explanation: The lateral motion of the pelvis should be slight, but there is a decided strong contraction of the lateral abdominal muscles. By the upward stretch of the arms the ribs and dorsal spine receive a beneficial upward pull.

EXERCISE VIII

Starting position: Standing — hands on head — flatten the lumbar curve and stretch up ribs.

Exercise: Bend the trunk left — repeat same to right.

Explanation: The upward stretch of ribs should be held firmly throughout the exercise, and when bending the trunk there should be a conscious contraction of the left side abdominal muscles and a strong upward pull on the ribs of the opposite side.

EXERCISE IX

Starting position: Hanging — carry legs slightly forward to flatten the lumbar curve.

Exercise: Raise left hip contracting side abdominal muscles — repeat same on right side.

Explanation: Carrying legs forward makes this a strong abdominal exercise and allows the contraction of the lateral abdominal muscles to be made with the pelvis held

in its correct position. Many progressive hanging exercises can be developed from this suggestion. They are difficult if the pelvic roll position is maintained through the exercises.

7. Round Shoulders

EXERCISE I

Starting position: Lie over edge of table — face down — feet on floor — clasp hands behind back.

Exercise: Roll shoulders backward.

Explanation: In this one-half prone-lying position the difficulties of the upright position are overcome. The shoulder blades should approximate each other. Rolling the shoulders backward stretches the pectoral muscles and brings into play the posterior shoulder muscles.

EXERCISE II

Starting position: Standing — clasp hands behind back — flatten lumbar curve — chest well over toes.

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Exercise: Roll shoulders backward.

Explanation: The upper back and especially the shoulder muscles are brought into play. The pectoral muscles are stretched.

EXERCISE III

Starting position: Stand facing corner of room. Place hands at shoulder height against walls — fingers pointing inward.

Exercise: Rise on toes — then force chest into corner — keeping elbows shoulder high.

Explanation: During this exercise it is most important to keep the low back flat. Do not allow the hips to sag forward. The conscious motion should be at the shoulder girdle. A strong pull is felt across the chest. The abnormal forward curve of the dorsal spine present in these cases is diminished.

8. Feet

EXERCISE I

Starting position: Sitting on table — feet raised

slightly from floor — toes pointing inward.

Exercise: Curl toes.

Explanation: Curl the toes under as if grasping a small marble. This exercise brings into play the intrinsic muscles of both the longitudinal and transverse arches and the flexor longus hallucis.

EXERCISE II

Starting position: Sitting on table — raise feet slightly from floor — knees straight.

Exercise: Foot circumduction.

Explanation: Point toes downward — inward — upward. When drawing feet upward curl the toes under as much as possible to raise the arch and bring into play the intrinsic muscles, and more important still, the adductors.

EXERCISE III

Starting position: Standing — hands on hips — toes pointing inward.

Exercise: Rise on toes, lower heels slowly keeping weight on outer border of feet.

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Explanation: When practicing standing foot exercises the correct body balance is as important as the foot exercises. Rising on toes and lowering heels slowly should be accomplished with the body held well poised and not allowed to sway.

EXERCISE IV

Starting position: Standing — hands on hips.

Exercise: Walk on tiptoes on line, pointing toes inward.

Explanation: Walking on tiptoes brings the plantar muscles into correct action. Pointing toes inward tends to throw the weight on outer half of feet, thus raising the longitudinal arch.

EXERCISE V

Starting position: Standing — hands on hips — feet parallel — one half inch apart.

Exercise: Roll weight on outer border, at the same time curling toes under.

Explanation: Rolling the weight on the outer

border places the foot in the best possible position to allow the adductors and intrinsic muscles to be contracted when curling toes.

EXERCISE VI

Starting position: Standing — hands on hips.

Exercise: Walk on straight line — heel of forward foot touching toe of rear foot each step.

Explanation: If the weight is thrown on the outer border of the feet and the body held well poised, this is a difficult foot as well as balance exercise.

EXERCISE VII

Starting position: Sitting.

Exercise: Curl toes under and pick up small marble from floor.

Explanation: Place the marble in the left hand from right foot and right hand from left foot. In addition to the intrinsic muscles active in grasping, the adductors are strongly brought into play.

EXERCISE VIII

Starting position: Standing on towel with feet parallel a short distance apart.

Exercise: Curl toes under, grasping towel — then draw toes inward — keeping heels apart.

Explanation: This strongly brings into play the intrinsic muscles and adductors.

EXERCISE IX

Starting position: Sitting — place a tape under the ball of foot, holding end of tape in each hand.

Exercise: Pull strongly on tape so as to flex the ankle to stretch the tendo Achillis.

Explanation: While stretching the tendon the toes should point inward. The value of this exercise lies in the added passive stretch to the tendon beyond the range of possible active motion.

9. Rib-Breathing

EXERCISE I

Starting position: Lying — hands on ribs — spread r b and hold ribs

immovable while breathing deeply.

Exercise:

Inhale and relax upper abdominal muscles, exhale by contracting abdominal muscles.

Explanation:

Since the diaphragm and the anterior abdominal muscles should coördinate their action through the respiratory center, the contraction of the diaphragm and the relaxation of the upper abdominal muscles should occur together, the abdominal wall being pushed outward by the pressure of the diaphragm transmitted through the abdomen. At expiration, by contraction of the upper abdominal muscles the intra-abdominal pressure is transmitted to the diaphragm, stimulating it to relax. The difference between this and the lying rest breathing exercise is the starting position. In the lying rest breathing exercise the antero-posterior diameter of the thorax is expanded. In this

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exercise the lateral diameter is expanded.

EXERCISE II

Starting position: Sitting — hands on ribs — spread ribs apart and hold them immovable while breathing deeply.

Exercise: Inhale and relax upper abdominal muscles, exhale by contracting abdominal muscles.

Explanation: See Exercise I.

EXERCISE III


Starting position: Standing — hands on ribs — spread ribs apart and hold ribs immovable while breathing deeply.

Exercise: Inhale and relax upper abdominal muscles, exhale by contracting abdominal muscles.

Explanation: See Exercise I.

EXERCISE IV

Starting position: Standing — hands behind neck — spread ribs apart and hold them immovable while breathing deeply.



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Exercise: Inhale and relax upper abdominal muscles, exhale by contracting abdominal muscles.

Explanation: See Exercise I.

TYPICAL DAY'S ORDER

I. LYING LIST

1. Lying Rest-Breathing
2. Lying Abdominal Retraction
3. Lying Rib-Stretching with Lateral Contraction
4. Lying Alternate Leg-Raising
5. Lying Rib-Breathing

A brief description of the above exercises is as follows:

1. *Starting position:* Lying — hands behind neck — elbows on table — raise chest and hold chest high while breathing deeply.

Exercise: Inhale and relax upper abdominal muscles, exhale by contracting abdominal muscles.

2. *Starting position:* Lying — hands at sides — knees bent — feet resting on table.

Exercise: Flatten the lumbar spine against the table by contracting the abdominal muscles.

3. *Starting position:* Lying — hands at sides.

Exercise: Raise one shoulder spread-

ing ribs apart — hold this upward stretch position and then contract side abdominal muscles. Alternate.

4. *Starting position:* Lying — hands back of neck — knees straight — flatten the lumbar curve against the table by contracting the abdominal muscles and rolling the pelvis as described in the lying Abdominal Retraction Exercise.

Exercise: Bend one knee over chest — straighten leg upward — lower slowly, keeping knee straight and back flat against table. Alternate.

5. *Starting position:* Lying — hands on ribs — spread ribs apart and hold ribs immovable while breathing deeply.

Exercise: Inhale and relax upper abdominal muscles, exhale by contracting the abdominal muscles.

II. STANDING LIST

1. Standing Chest-Breathing

2. Standing Abdominal Retraction
3. Tall Walk
4. Sitting Alternate Rib-Stretching
5. Standing Trunk-Bending
6. Standing Rib-Breathing

1. *Starting position:* Standing — hands on hips, raise chest high and hold chest high while breathing deeply.

Exercise: Inhale and relax upper abdominal muscles, exhale by contracting abdominal muscles.

2. *Starting position:* Stand with heels four inches from the wall — hips, shoulders, head touching wall — hands at sides.

Exercise: Straighten the lumbar curve against the wall by contracting the abdominal and gluteal muscles.

3. *Starting position:* Stretch arms forward-upward as if reaching, contract the abdominal and gluteal muscles, thus flattening the back. Stretch up chest and ribs — head up, chin in.

Exercise: Walk on tiptoes on line.

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4. *Starting position:* Sitting — hands on head.
Exercise: Raise one shoulder elevating ribs on one side, repeat same on opposite side, then raise shoulders equally to simultaneously elevate ribs on both sides.
5. *Starting position:* Standing — hands on hips — straighten the lumbar curve.
Exercise: Bend the trunk forward.
6. *Starting position:* Standing — hands on ribs — spread ribs apart and hold ribs immovable while breathing deeply.
Exercise: Inhale and relax upper abdominal muscles, exhale by contracting abdominal muscles.

III. PROGRESSIVE STANDING LIST

1. Standing Deep Breathing
2. Standing Abdominal Retraction
3. Standing Turkey Walk
4. Standing Lateral Contraction
5. Lying Alternate Leg-Raising
6. Standing Trunk-Bending Forward
7. Standing Rib-Stretching

8. Standing Rib-Breathing

1. *Starting position:* Hands behind neck — raise chest high and hold chest high while breathing deeply.

Exercise: Inhale and relax upper abdominal muscles, exhale by contracting abdominal muscles.

2. *Starting position:* Stand with heels four inches from the wall — hips, shoulders, head touching wall — hands at sides.

Exercise: Straighten the lumbar curve against the wall by contracting the abdominal and gluteal muscles.

3. *Starting position:* Stretch arms forward-upward as if reaching, contract the abdominal and gluteal muscles, flattening the back, stretch up chest and ribs — head up — chin in.

Exercise: Bend one knee upward — straighten leg forward — step. Bend other knee — straighten leg forward — and step.

4. *Starting position:* Standing — hands at sides.

PROGRESSIVE STANDING LIST 111

Exercise: Raise one shoulder elevating ribs — hold this upward stretch position and then contract side abdominal muscles. Alternate.

5. *Starting position:* Lying — hands back of the neck — knees straight. Flatten the lumbar curve against the table by contracting the abdominal muscles and rolling the pelvis as described in the lying abdominal retraction exercise. (Page 78.)

Exercise: Raise leg — lower slowly keeping back flat. Alternate.

6. *Starting position:* Standing — hands behind neck — straighten the lumbar curve.

Exercise: Bend the trunk forward.

7. *Starting position:* Standing — hands behind neck.

Exercise: Raise one shoulder elevating ribs on one side, repeat same on opposite side — then raise shoulders equally to simultaneously elevate ribs on both sides.

8. *Starting position:* Standing — hands behind neck — spread ribs apart and hold them immovable while breathing deeply.

Exercise:

Inhale and relax upper abdominal muscles, exhale by contracting abdominal muscles.

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